



(12) **EUROPEAN PATENT APPLICATION**

(88) Date of publication A3:
15.01.2025 Bulletin 2025/03

(51) International Patent Classification (IPC):
B01D 53/04 ^(2006.01) **B01D 53/62** ^(2006.01)

(43) Date of publication A2:
28.08.2024 Bulletin 2024/35

(52) Cooperative Patent Classification (CPC):
B01D 53/04; B01D 53/62; B01D 53/82;
B01D 53/965; B01D 2257/504; B01D 2258/06;
B01D 2259/40083; Y02C 20/40

(21) Application number: **24154871.8**

(22) Date of filing: **31.01.2024**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH MA MD TN

(72) Inventors:
• **Kitchaev, Daniil**
Sommerville, 02144 (US)
• **Gorlin, Yelena**
Menlo Park, 94025 (US)
• **Tuffile, Charles**
Swansea, 02777 (US)

(30) Priority: **31.01.2023 US 202318162326**

(74) Representative: **Isarpatent**
Patent- und Rechtsanwälte
Barth Hassa Peckmann & Partner mbB
Friedrichstraße 31
80801 München (DE)

(71) Applicant: **Robert Bosch GmbH**
70469 Stuttgart (DE)

(54) **ATMOSPHERIC CARBON DIOXIDE CAPTURE SYSTEM**

(57) An atmospheric CO₂ capture system includes a compartment housing a solid CO₂ sorbent, an exchange fluid including a chemical component with selectivity towards CO₂, and an electrochemical cell in fluid communication with the compartment, the system having a cycle including a first state of sorbing CO₂ from incoming air onto the solid CO₂ sorbent until a saturation point is

reached; a second state of regenerating the sorbent by flooding the compartment with the exchange fluid to detach CO₂ from the saturated sorbent and bind the detached CO₂ to the chemical component; and a third state of regenerating the chemical component by detaching CO₂ from the chemical component in the electrochemical cell and releasing the CO₂ from the system.

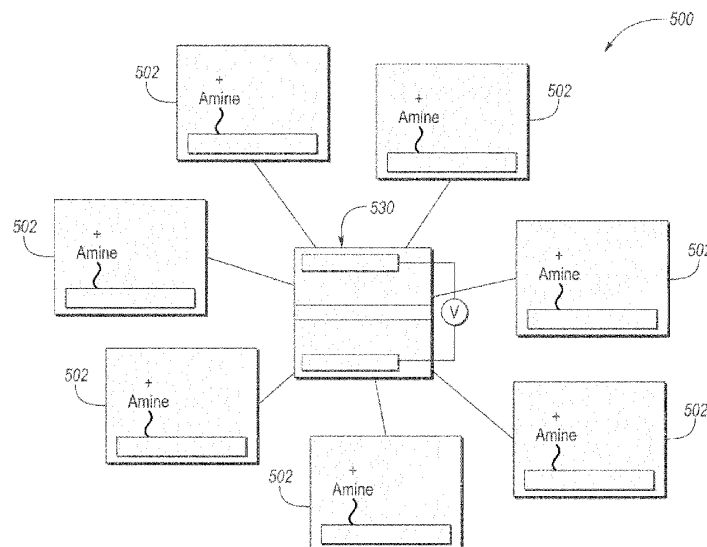


FIG. 3



EUROPEAN SEARCH REPORT

Application Number

EP 24 15 4871

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2021/340076 A1 (SCHUETZLE ROBERT [US] ET AL) 4 November 2021 (2021-11-04) * paragraphs [0007] - [0009], [0029] - [0032]; claims 1-3; figures 1-5 *	1-20	INV. B01D53/04 B01D53/62
X	WO 2008/042919 A2 (GLOBAL RES TECHNOLOGIES LLC [US]; WRIGHT ALLEN B [US] ET AL.) 10 April 2008 (2008-04-10) * page 7, line 31 - page 8, line 16; figures 8-9 *	1,3-5,7,8	
A	* page 11, line 31 - page 12, line 28 *	2,6	
A	RENFREW SARA E. ET AL: "Electrochemical Approaches toward CO 2 Capture and Concentration", ACS CATALYSIS, vol. 10, no. 21, 26 October 2020 (2020-10-26), pages 13058-13074, XP093071369, US ISSN: 2155-5435, DOI: 10.1021/acscatal.0c03639 * section 2.1, 2.3, 4 *	1-20	TECHNICAL FIELDS SEARCHED (IPC) B01D
A	WO 2022/020634 A1 (ATWOOD MATTHEW [US]) 27 January 2022 (2022-01-27) * paragraphs [0059] - [0061]; claims 1-6; figures 1-2 *	1,9,15	
A	US 2010/326272 A1 (ASARO MARIANNA F [US] ET AL) 30 December 2010 (2010-12-30) * paragraphs [0030] - [0031], [0055] - [0058]; claims 11-6, 15-28; figures 1-2, 6 *	1-20	
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		24 November 2024	Ruiz Martinez, Maria
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			



EUROPEAN SEARCH REPORT

Application Number

EP 24 15 4871

DOCUMENTS CONSIDERED TO BE RELEVANT

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	QINGDIAN SHU: "Direct Air Capture Using Electrochemically Regenerated Anion Exchange Resins", ENVIRONMENTAL SCIENCE & TECHNOLOGY, vol. 56, no. 16, 16 August 2022 (2022-08-16), pages 11559-11566, XP093156440, US ISSN: 0013-936X, DOI: 10.1021/acs.est.2c01944 Retrieved from the Internet: URL:https://pubs.acs.org/doi/pdf/10.1021/acs.est.2c01944> * abstract; figure 1 * * the whole document * -----	1-8	
			TECHNICAL FIELDS SEARCHED (IPC)
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		24 November 2024	Ruiz Martinez, Maria
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

EPO FORM 1503 03.82 (P04C01)



Application Number

EP 24 15 4871

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



LACK OF UNITY OF INVENTION **SHEET B**

Application Number

EP 24 15 4871

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-8

An atmospheric CO₂ capture system comprising a compartment housing a solid CO₂, an exchange fluid includes a chemical component with selectivity towards CO₂ sorbent and an electrochemical cell.

2. claims: 9-14

an atmospheric CO₂ capture system comprising a solid amine-functional exchange solution, a first chemical component with a selectivity towards amines; a second exchange solution including a second chemical component with a selectivity towards the first chemical component, sized CO₂ sorbent, and an electrochemical cell.

3. claims: 15-20

an atmospheric CO₂ capture system comprising a solid amine-functional exchange solution, an exchange fluid including a first chemical component with a preferential affinity towards CO₂, amines, or a second chemical component; and an electrochemical cell.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 24 15 4871

24-11-2024

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2021340076 A1	04-11-2021	AU 2021268532 A1	01-12-2022
		BR 112022021340 A2	11-04-2023
		CA 3180810 A1	11-11-2021
		CA 3215266 A1	11-11-2021
		CL 2022002929 A1	07-07-2023
		CL 2023003804 A1	02-08-2024
		CN 115485052 A	16-12-2022
		EP 4146372 A1	15-03-2023
		JP 2023528732 A	06-07-2023
		KR 20230004859 A	06-01-2023
		US 2021340076 A1	04-11-2021
		US 2023373882 A1	23-11-2023
WO 2008042919 A2	10-04-2008	WO 2021225642 A1	11-11-2021
		AU 2007303240 A1	10-04-2008
		CA 2664464 A1	10-04-2008
		CN 101998876 A	30-03-2011
		CN 104826450 A	12-08-2015
		EP 2077911 A2	15-07-2009
		ES 2784490 T3	28-09-2020
		HK 1150307 A1	25-11-2011
		JP 5849327 B2	27-01-2016
		JP 6204333 B2	27-09-2017
		JP 2010505613 A	25-02-2010
		JP 2015120154 A	02-07-2015
		KR 20090086530 A	13-08-2009
		NZ 575870 A	24-02-2012
		RU 2009116621 A	10-11-2010
		US 2008087165 A1	17-04-2008
		US 2010105126 A1	29-04-2010
		US 2011027142 A1	03-02-2011
		US 2011027143 A1	03-02-2011
		US 2011027157 A1	03-02-2011
		US 2011033357 A1	10-02-2011
		US 2011033358 A1	10-02-2011
		US 2011079144 A1	07-04-2011
		US 2011079146 A1	07-04-2011
		US 2011079147 A1	07-04-2011
		US 2011079149 A1	07-04-2011
		US 2011079150 A1	07-04-2011
		US 2011081709 A1	07-04-2011
		US 2011081710 A1	07-04-2011
		US 2011081712 A1	07-04-2011
		US 2011083554 A1	14-04-2011
		US 2013309756 A1	21-11-2013
		US 2015020683 A1	22-01-2015

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 24 15 4871

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

24-11-2024

10	Patent document cited in search report		Publication date	Patent family member(s)		Publication date
				US 2017028347 A1		02-02-2017
				WO 2008042919 A2		10-04-2008

15	WO 2022020634	A1	27-01-2022	AU 2021313222 A1		16-02-2023
				BR 112023000962 A2		28-03-2023
				CA 3186676 A1		27-01-2022
				CN 116133744 A		16-05-2023
				EP 4076701 A1		26-10-2022
20				IL 300037 A		01-03-2023
				JP 2023535006 A		15-08-2023
				KR 20230059783 A		03-05-2023
				US 2022379262 A1		01-12-2022
				WO 2022020634 A1		27-01-2022

25	US 2010326272	A1	30-12-2010	JP 2012531299 A		10-12-2012
				US 2010326272 A1		30-12-2010
				WO 2010151271 A1		29-12-2010

30						
35						
40						
45						
50						
55						

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82